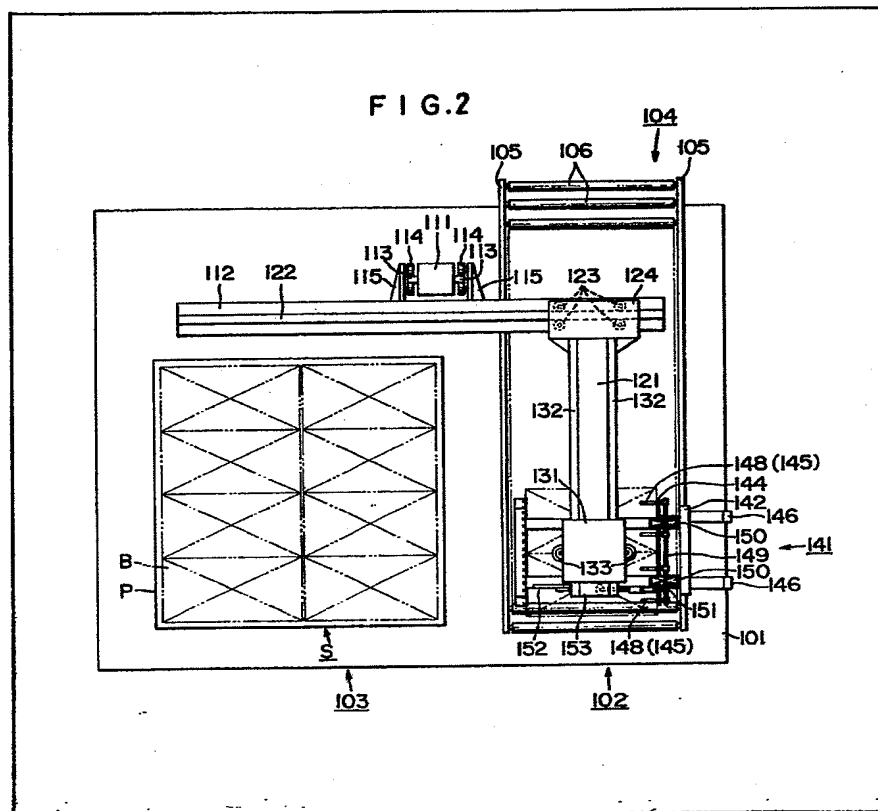


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## (54) Pallet loading apparatus

(57) A pallet loading wherein a carrying-in unit (104) for supplying articles (B) to be loaded and a carrying-out unit (103) having a pallet (P) placed thereon for loading are disposed adjacent to each other, includes an upright post (111) in the vicinity of said units, and an elongate horizontal lift (112) which is movable up and down on the post (111). A horizontal trolley (121) which extends transversely of the lift (112), is movable along the lift (112) in a horizontal direction between the carrying-in and carrying-out units and

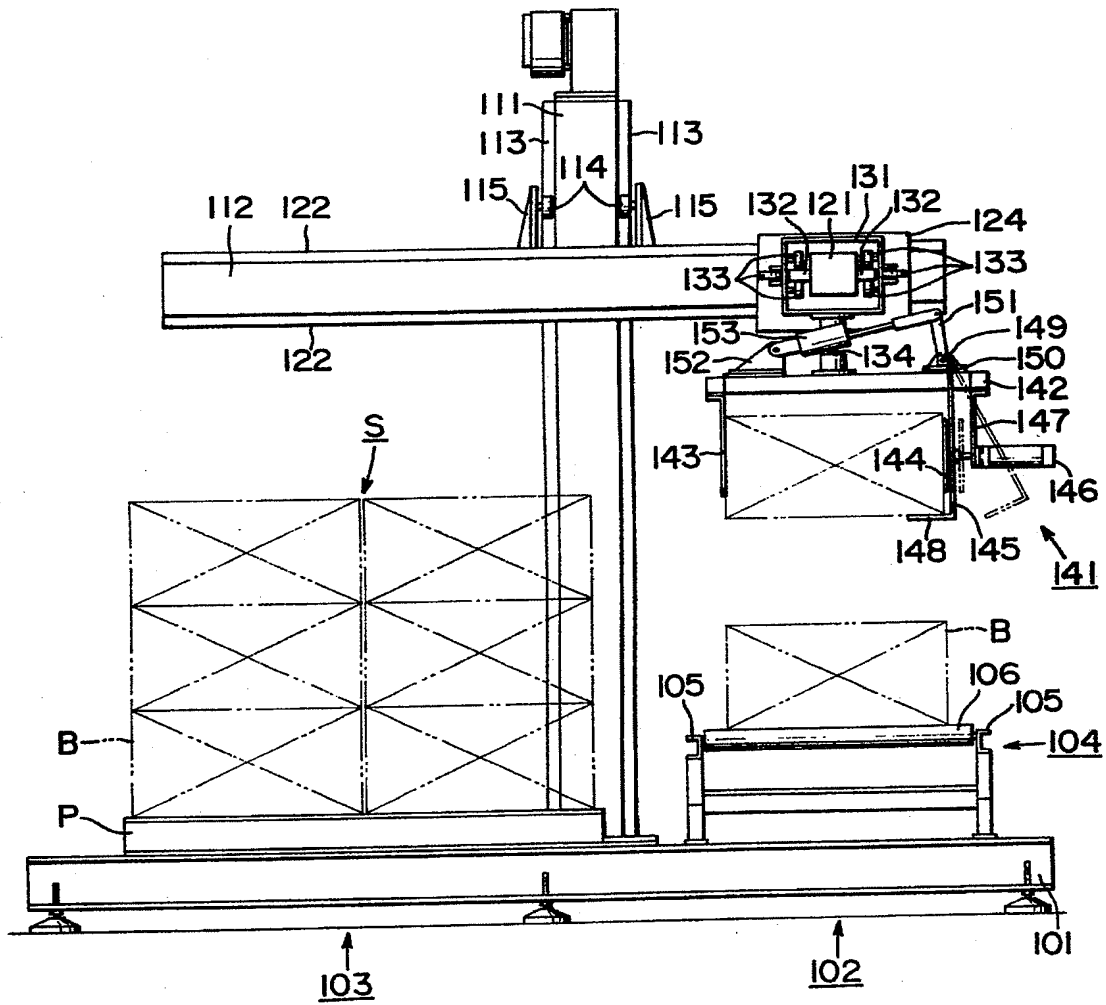
mounts a carriage (131) which is movable therealong and suspends a holding mechanism (141) for the articles. The articles are transferred and loaded onto the pallet (P) by holding articles, which are carried into the carrying-in unit (104), in the holding mechanism (141) and transferring the thus held articles to the pallet at the carrying-out unit (103) both by the ascent and descent of the lift (112), the horizontal movement of the trolley (121), the horizontal movement, if necessary, of the carriage (131), and by releasing the articles from the holding mechanism (141).



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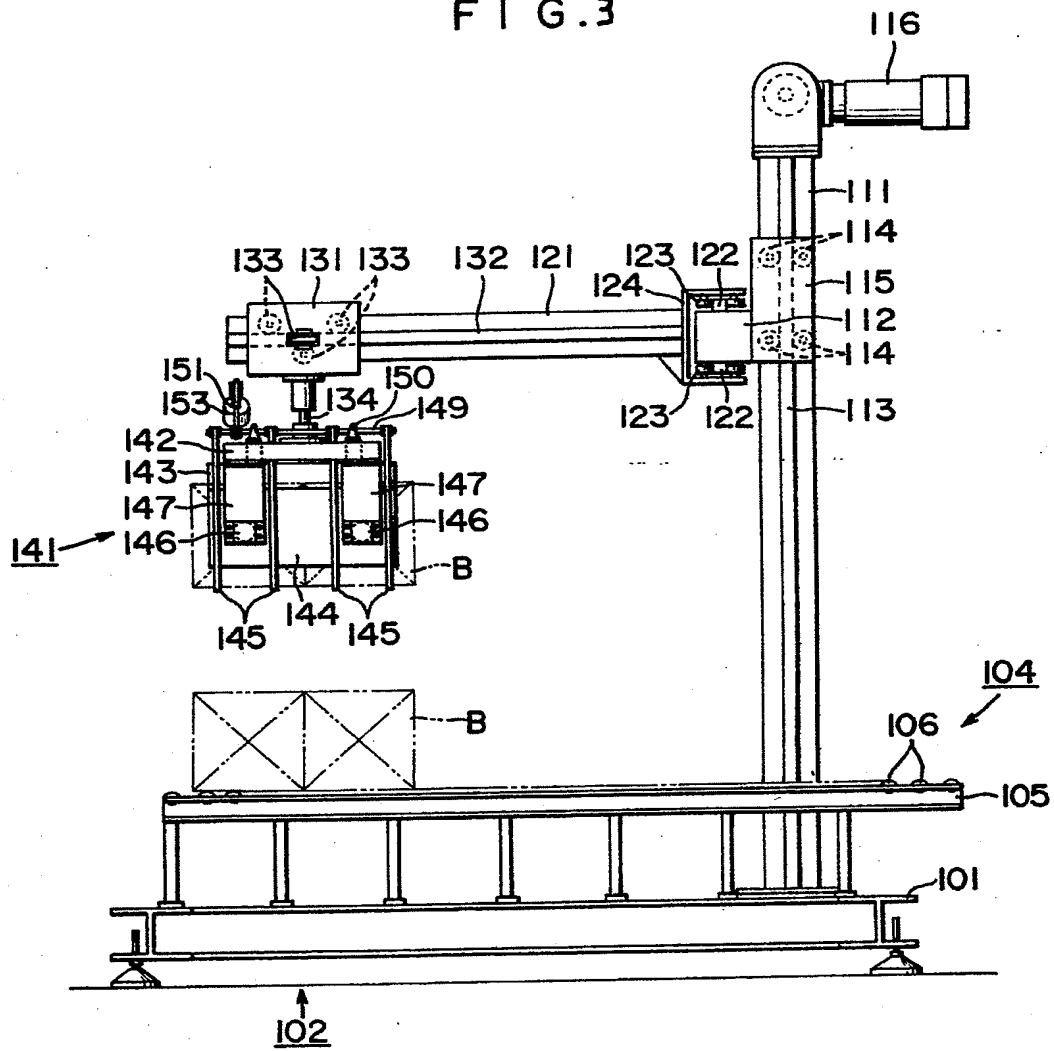
FIG. 1



**FIG. 2**

FIG. 2 is a schematic diagram of a mechanical assembly, likely a printer or copier, showing a top-down view of a frame with various components labeled with reference numerals. The assembly includes a central vertical support structure, a horizontal base, and a complex mechanism on the right side. Key components include a frame (101), a central support (132), a base (102), and a mechanism (103) with various sub-components like rollers (104, 105, 106), guides (112, 113, 114, 115), and a motor or actuator (133). The mechanism also includes a series of rollers or guides (141, 142, 143, 144, 145, 146) and a final output or collection area (151). The diagram uses solid lines for visible parts and dashed lines for hidden internal components.

FIG. 3



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FIG. 4

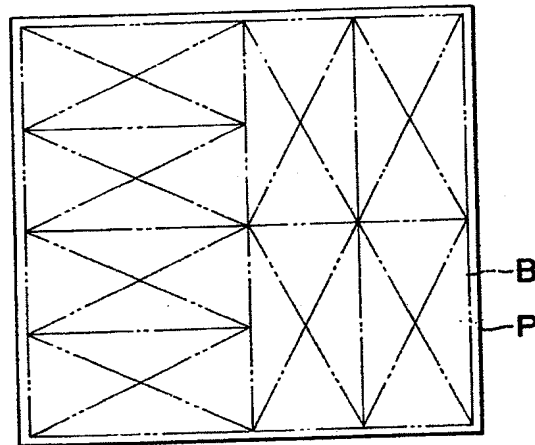


FIG. 5

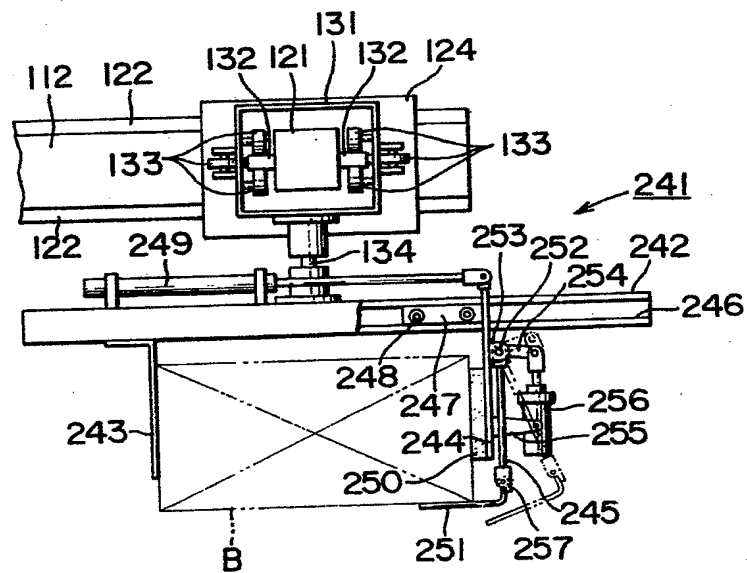
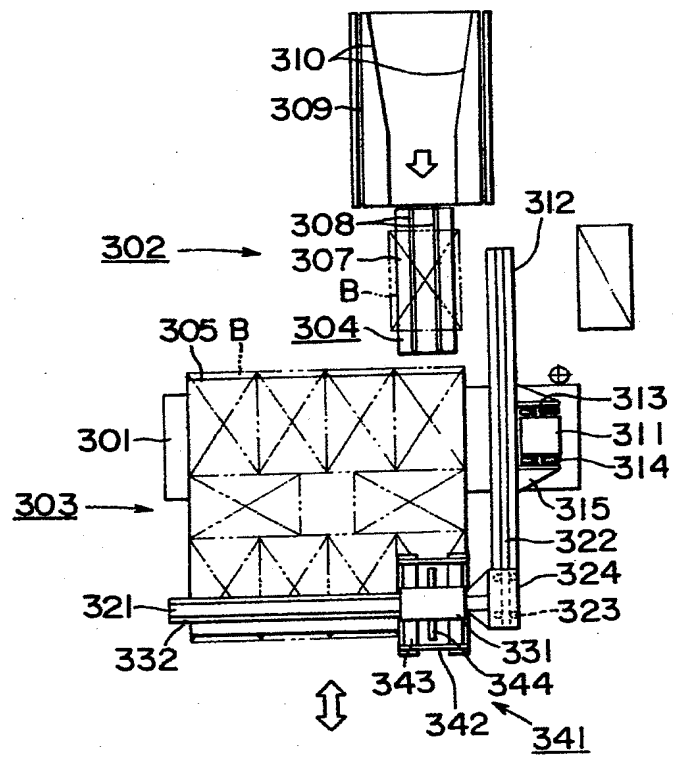


FIG. 6



A perspective view of a measuring device. The device consists of a base 300 supporting a vertical column 311. At the top of the column is a horizontal arm 312. The arm has a sliding component 316 with a handle 314 and a locking mechanism 315. A vertical rod 322 passes through the center of the arm, secured by a nut 323. A horizontal rod 332 extends from the end of the arm, passing through a series of bushings or guides labeled 331, 333, and 324. This rod terminates in a probe tip 341. Below the probe tip is a scale assembly 342, which includes a scale bar 343 and a reading window 344. The entire assembly is positioned above a rectangular object B, which is placed on a platform P. The platform P is supported by a frame 305 and 306.

FIG. 9(A)

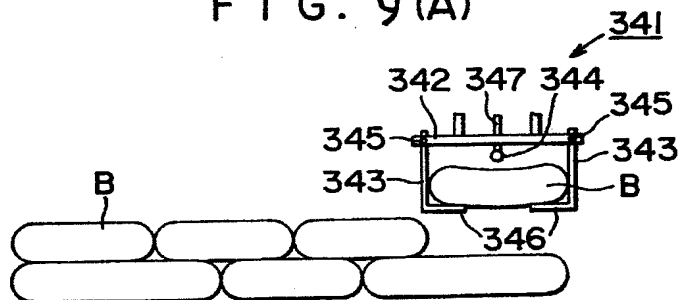


FIG. 9(B)

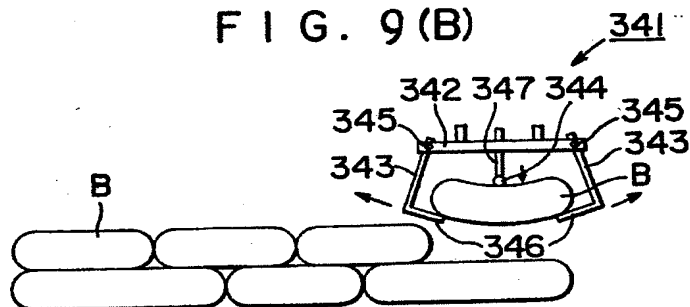


FIG. 9(C)

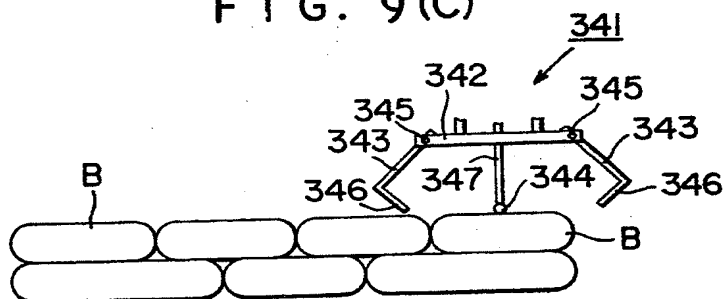




FIG. 10

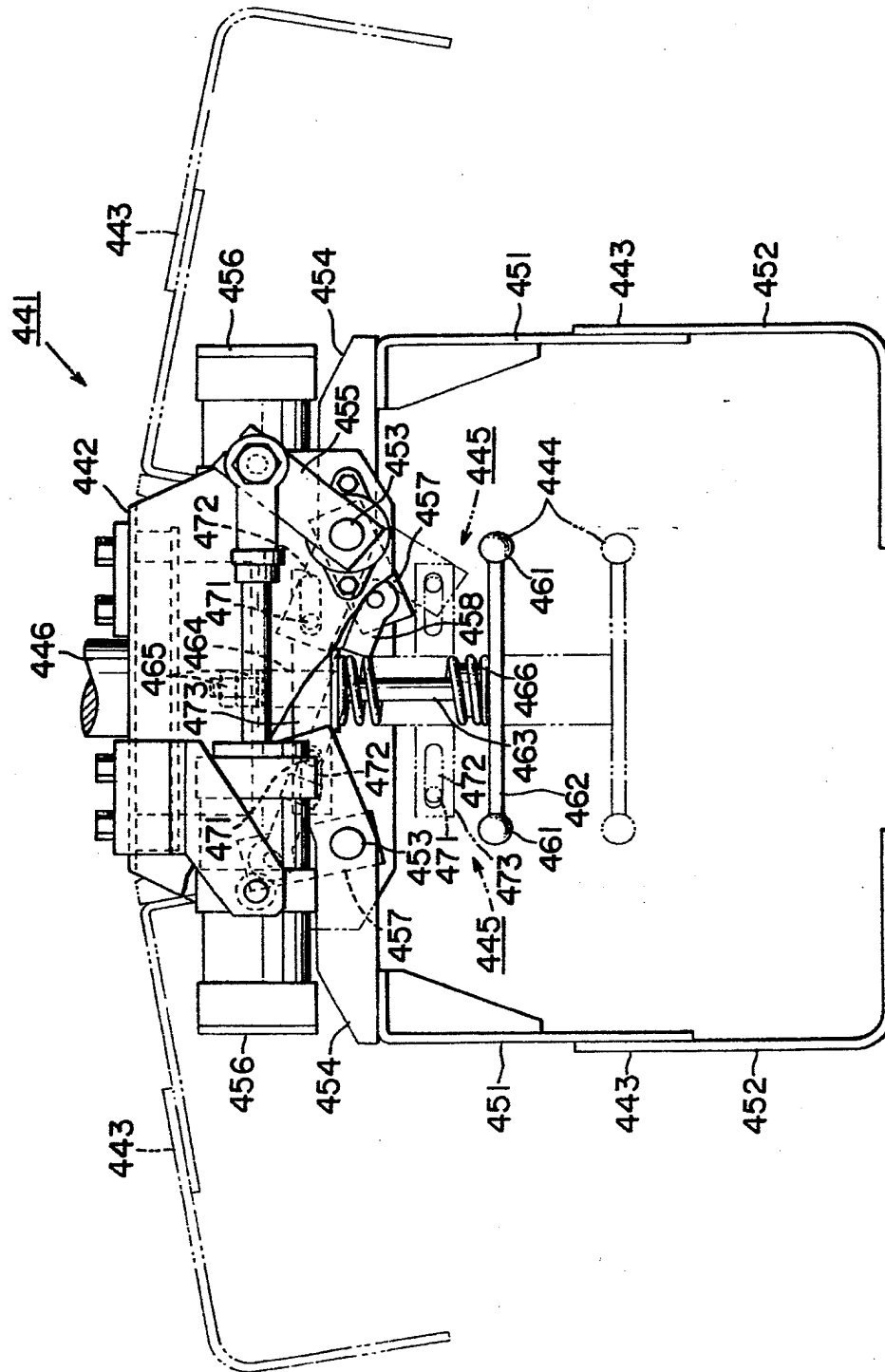
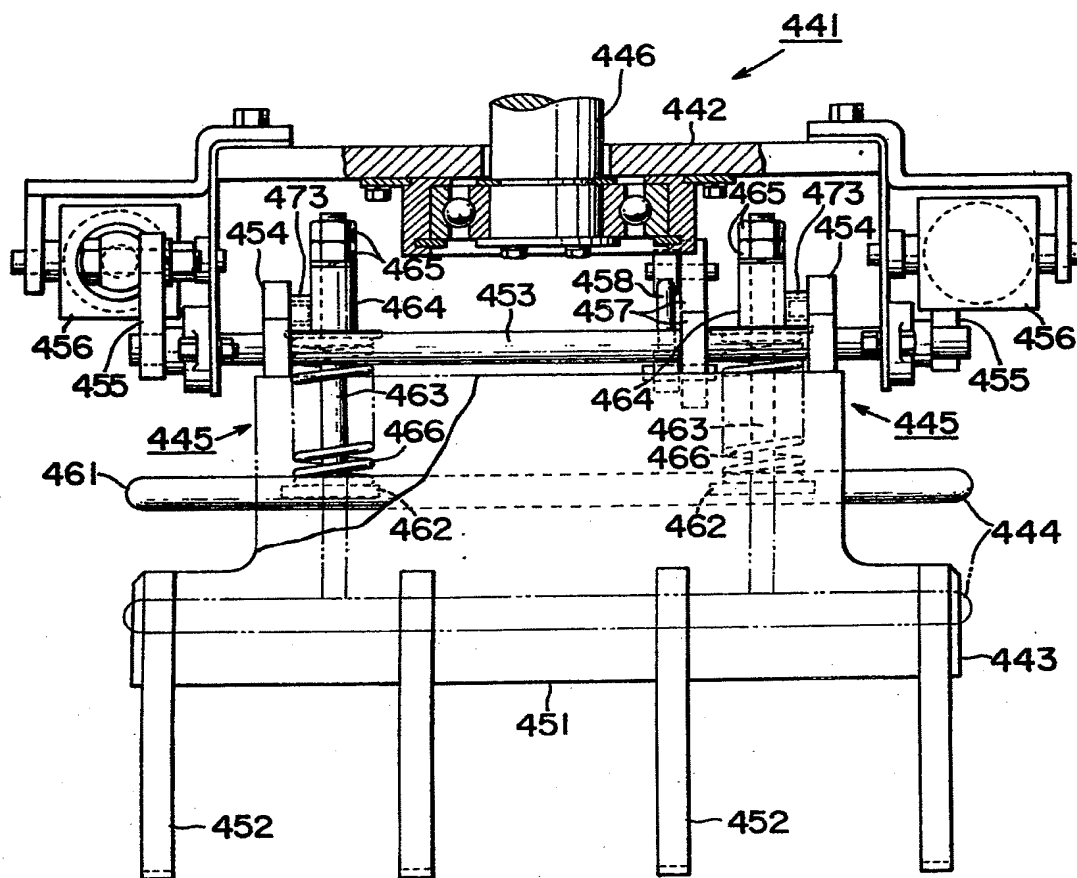


FIG. II



## SPECIFICATION

## Pallet loading apparatus

5 The present invention relates to a pallet loading apparatus for loading articles on a predetermined pattern and in a piled manner upon a pallet.

A pallet loading apparatus according to the prior art loads a pallet with articles by carrying in a predetermined number of articles for one layer and arranging them on an arranging table, by loading the articles for one layer from the arranging table onto a carriage, by bringing the carriage to above a pallet and then retaining the articles for one layer on the carriage with the use of a stopper, and then by retracting the carriage thereby to allow the articles for one layer to drop onto the pallet.

In the case of the conventional pallet loading apparatus thus far described, however, since a large load is exerted upon the carriage and its moving and supporting unit and since the articles are piled in multiple layers, there are required not only both a mechanism for moving up and down the carriage and its moving and supporting unit, which are highly loaded, and a mechanism for moving up and down the pallet loaded with the articles but also a space for allowing the carriage to retract. As a result, the pallet loading apparatus has its size enlarged as a whole.

The present invention has been conceived in view of the problems thus far described and contemplates to provide a simplified type pallet loading apparatus.

It is a first object of the present invention to simplify the construction and reduce the size of a pallet loading apparatus by loading a row of articles for one layer plural times. In order to achieve this object, the pallet loading apparatus according to the present invention is constructed such that a carrying-in unit for carrying in respective articles and a carrying-out unit having a pallet placed thereon for loading the articles are disposed adjacent to each other, such that a post is erected upright in the vicinity of those carrying-in and carrying-out units, such that there is disposed on that post a lift which is elongated in a horizontal direction along those carrying-in and carrying-out units and which is enabled to move up and down on that post, such that there is carried on the aforementioned lift a transverse trolley which is made movable in a horizontal direction between those carrying-in and carrying-out units, and such that a holding mechanism for holding the articles is suspended from the lower portion of that transverse trolley. Thus, the pallet loading apparatus transfers and loads the articles onto the pallet by holding a row of articles, which are carried in onto the carrying-in unit, in the holding mechanism, by transferring the articles, which are held in the holding mechanism to the carrying-out unit both by the ascend and descend of the lift and the horizontal movement of the transverse trolley, and by releasing the articles from the holding mechanism.

In order to achieve the aforementioned object,

moreover, the pallet loading apparatus having the constructions thus far described is constructed such that there is carried on the transverse trolley a carriage which is made movable in such a horizontal direction as to intersect the moving directions of the transverse trolley, and such that the aforementioned holding mechanism is carried on that carriage, whereby a row of articles are divided and transferred plural times onto the carrying-out unit.

In the aforementioned respective pallet loading apparatus, moreover, in addition to the advantage that box-shaped articles can be loaded by the use of the holding mechanism equipped with a pair of clamping members, the positioning operations of the box-shaped articles and the holding mechanism both at the carrying-in unit is enabled to have their degrees of freedom relatively increased by driving both the paired clamping members of the holding mechanism to move toward and away from each other so that the positioning operations can be facilitated to ensure the clamping and holding operations of the box-shaped articles.

In the case of the aforementioned holding mechanism having both its paired clamping members driven, still moreover, the holding mechanism itself is enabled to have its construction simplified and its size reduced by driving both the clamping members by means of a single cylinder.

In the aforementioned respective pallet loading apparatus, furthermore, in addition to the advantage that the box-shaped articles can be loaded by the use of the holding mechanism having the paired clamping members, the gap between the box-shaped articles loaded on the pallet can be remarkably reduced by driving only one of the paired clamping members of the holding mechanism to move it toward and away from the other.

By equipping the aforementioned respective holding mechanisms having the paired clamping members with a supporting member which is adapted to move to and from below the box-shaped articles, furthermore, the box-shaped articles are clamped with a suitable force between the paired clamping members, and the box-shaped articles thus clamped between the clamping members are prevented exclusively by that support member from dropping down so that they can be prevented from being broken by the clamping forces of the clamping members.

In the aforementioned respective pallet loading apparatus, furthermore, bag-shaped articles can also be loaded by the use of a holding mechanism which is equipped with a pair of scooping members.

In the case of the aforementioned pallet loading apparatus equipped with the paired scooping members, the deformations of the bag-shaped articles and the unbalance of the load are corrected, by disposing vertically movably a push member for pushing down a bag-shaped article between the paired scooping members, so that the bag-shaped articles piled on the pallet can be prevented from dropping to pieces.

In the case of the aforementioned holding mechanism,

ism equipped with the push member between the paired scooping members, moreover, the holding mechanism itself can have its construction simplified and its size reduced by moving up and down the push member in mechanical response to the opening and closing operations of the paired scooping members.

In the aforementioned respective pallet loading apparatus, still moreover, the box- or bag-shaped articles can be loaded on various patterns disposing the holding mechanism, which is made operative to hold the box- or bag-shaped article, on either the transverse trolley or the carriage such that it can rotate in a horizontal plane.

Other objects and advantages of the present invention will become apparent from the following description to be made with reference to the accompanying drawings.

Fig. 1 is a front elevation showing a first embodiment of the pallet loading apparatus according to the present invention;

Fig. 2 is a top plan view of the same;

Fig. 3 is a side elevation of the same;

Fig. 4 is a top plan view showing the loading state of the same;

Fig. 5 is a front elevation showing a second embodiment of the pallet loading apparatus of the present invention, and particularly the holding mechanism of the same;

Fig. 6 is a top plan view showing a third embodiment of the pallet loading apparatus according to the present invention;

Fig. 7 is a front elevation of the same;

Fig. 8 is a top plan view of an essential portion of the same;

Figs. 9(A), 9(B) and 9(C) are explanatory views illustrating the operations of the holding mechanism of the same;

Fig. 10 is a front elevation showing a fourth embodiment of the pallet loading apparatus of the present invention, and particularly the holding mechanism of the same; and

Fig. 11 is a side elevation showing the same holding mechanism.

The present invention will now be specifically described in connection with the embodiments thereof with reference to the accompanying drawings.

First of all, the following description is directed to a plurality of embodiments for loading box-shaped articles.

Figs. 1 to 4 show a first embodiment of the pallet loading apparatus according to the present invention.

Reference numeral 101 appearing in Figs. 1 to 3 generally indicates a horizontal platform at both the sides of which there are disposed adjacent to each other a carrying-in unit 102 for the box-shaped articles B and a carrying-out unit 103 for loading the articles B. At the carrying-in unit 102 at the righthand side, there is disposed the leading end portion of a carrying-in conveyor 104 for separately conveying the articles B. The pallet P is placed on the carrying-out unit 103 at the lefthand side.

Moreover, the aforementioned carrying-in conveyor 104 is so constructed that a number of rollers 106 are juxtaposed to one another and borne between

two side frames 105. A predetermined number, e.g., two articles B, which are divided longitudinally into two halves for one row, are successively conveyed, while being oriented in a predetermined direction, by the action of the carrying-in conveyor 104 until they are stopped at the leading end portion of the conveyor 104 by means of a not shown stopper.

Incidentally, a pallet conveyor for conveying the pallet P may be disposed at the carrying-out unit 103 similarly to the carrying-out conveyor 104 described in the above.

In the vicinity of the aforementioned carrying-in and carrying-out units 102 and 103, moreover, there is erected upright at the back of the aforementioned platform 101 a stationary post 111. On this stationary post 111 at the side of the carrying-in and carrying-out units 102 and 103, i.e., at the front side thereof, there is vertically movably disposed a lift 112 which is elongated in a horizontal direction along the carrying-in and carrying-out units 102 and 103, i.e., in a transverse direction.

Specifically, the aforementioned stationary post 111 is equipped at its both sides with vertical guide rails 113. On the rear portion of the aforementioned lift 112, moreover, there are borne through a pair of brackets 115 a plurality of rollers 114, which are in engagement with the aforementioned guide rails 113. Still moreover, the lift 112 is moved up and down by means of a drive mechanism which is composed of a motor 116 mounted on the upper end portion of the stationary post 111.

On the lift 112 at the side of the carrying-in and carrying-out units 102 and 103, i.e., at the front side thereof, on the other hand, there is disposed a transverse trolley 121 which is elongated in a horizontal direction to intersect the lift 112, i.e., in a longitudinal direction and which is made movable in a horizontal direction between the carrying-in and carrying-out units 102 and 103.

Specifically, the aforementioned lift 112 is equipped at its upper and lower portions with transversely horizontal guide rails 122. On the rear end portion of the aforementioned transverse trolley 121, moreover, there are borne through a supporting frame 124 having a generally C-shaped side view a plurality of rollers 123, which are in engagement with the aforementioned guide rails 122. Still moreover, the transverse trolley 121 is adapted to move in a horizontal direction by the action of a not-shown drive mechanism.

On the aforementioned transverse trolley 121, furthermore, there is carried in an enclosing manner a carriage 131 having a generally rectangular front view, which is made movable in a horizontal direction to intersect the moving direction of the transverse trolley 121.

Specifically, this transverse trolley 121 is equipped at both its side portions with longitudinally horizontal guide rails 132. On both the side portions of the aforementioned carriage 131, moreover, there are respectively borne a plurality of rollers 133, which are in engagement with the aforementioned guide rails 132. Still moreover, the carriage 131 is adapted to move in a horizontal direction by the action of a not-shown drive mechanism.

On the other hand, a holding mechanism 141 for holding the articles B is suspended from the lower portion of the aforementioned carriage 131. That holding mechanism 141 is constructed to include a supporting frame 142, which is supported on the carriage 131, a first plate-shaped clamping member 143, which is mounted on that supporting frame 142 at the lower portion thereof at the lefthand side, i.e. at the side of the carrying-out unit 103, a second plate-shaped clamping member 144, which is mounted on the supporting frame 142 at the lower portion thereof at the righthand side, i.e. at the side of the carrying-in unit 102 in a position opposite to the first clamping member 143, and a plurality of generally L-shaped supporting members 145 which are mounted on the righthand side lower portion and which are positioned outside of the aforementioned second clamping member 144.

In the embodiment being described, the aforementioned supporting frame 142 is so suspended from the lower portion of the aforementioned carriage 131 through a shaft 134 as to rotate in a horizontal plane and is rotated by the action of a not-shown drive mechanism.

In this embodiment, moreover, the first clamping member 143 is fixedly mounted on the lefthand lower portion of the aforementioned supporting frame 142.

On the other hand, the second clamping member 144 is adapted to move toward and away from the aforementioned first clamping member 143 so that it may clamp a predetermined number of articles B between itself and the first clamping member 143. Specifically, that second clamping member 144 is attached to the leading end portions of the piston rods of a pair of air cylinders 146, which in turn are attached to the lower end portions of mounting plates 147 attached to the righthand lower portion of the aforementioned supporting frame 142, so that it can be brought toward and away from the first clamping member 143 by actuating the air cylinders 146 to protrude and retract their piston rods.

The aforementioned supporting members 145 are so constructed that horizontal supporting portions formed at their lower ends can move from the outside of the second clamping member 144 toward and away from the righthand lower portion or portions of the article B or articles B between the aforementioned first and second clamping members 143 and 144 thereby to prevent the article B or articles B from dropping down from between the first and second clamping members 143 and 144. Specifically, those supporting members 145 are secured at their base end portions to a single pivot pin 149, which is rotatably supported on the righthand upper portion of the aforementioned supporting frame 142 through a pair of bearings 150. To that pivot pin 149, there is secured one end of a drive lever 151, which has its other end hingedly connected to the leading end portion of the piston rod of an air cylinder 153 hinged to the upper portion of the aforementioned supporting frame 142 through a bracket 152. By actuating the air cylinder 153 to protrude and retract its piston rod, the supporting members 145 are rocked about the pivot pin 149 so that their supporting portions 148 approach and leave the righthand lower portion of

the articles B between the aforementioned first and second clamping members 143 and 144 from the outside of the second clamping member 144. In this embodiment, moreover, the supporting portions 148 are arcuately moved back and forth by rocking the supporting members 145. However, the supporting members 145 can be linearly moved by suitable means so that their supporting portions 148 can be linearly moved back and forth.

The operations of the embodiment having the construction thus far described will be described in the following.

A predetermined number of articles B are fed to the carrying-in conveyor 104 and they are stopped at the leading end portion of the conveyor 104, which is disposed at the carrying-in unit 102.

Then, the lift 112 is moved down along the stationary post 111 to a predetermined position so that the first and second clamping members 143 and 144 of the holding mechanism 141 are brought to both sides of the articles B. After that, the air cylinders 146 are actuated to protrude their piston rods so that the second clamping member 144 is brought toward the first clamping member 143 thereby to clamp the articles B. Then, the air cylinder 153 is actuated to protrude its piston rod so that the supporting portions 148 of the supporting members 145 are protruded to below the righthand lower portions of the articles B from the back of the second clamping member 144 thereby to support the articles B.

Then, the lift 112 is moved up, and the transverse trolley 121 is moved to the left along the lift 112. If necessary, moreover, the carriage 131 is moved forward or backward along the transverse trolley 121 so that not only the first and second clamping members 143 and 144 but also the articles B held by the supporting members 145 are brought to above the predetermined piling position at the lefthand front or rear portion of the pallet P which is placed on the carrying-out unit 103.

Next, the lift 112 is moved down to bring down the articles B to the predetermined piling position of the lefthand front or rear portion above the pallet P. After that, the air cylinder 153 is actuated to retract its piston rod so that the supporting portions 148 of the supporting members 145 are extracted from the righthand lower portion of the articles B. After that, the air cylinder 146 is actuated to retract its piston rod so that the second clamping member 144 is retracted to release the articles B.

Then, the lift 112 is moved up, and the transverse trolley 121 is moved to the right. If necessary, moreover, the carriage 131 is moved forward or backward so that the holding mechanism 141 is positioned above the leading end portion of the carrying-in conveyor 104.

Moreover, the operations thus far described are successively carried out to transfer the predetermined number of articles B to the predetermined piling positions at the lefthand front and rear portions and the righthand front and rear portions of the pallet P, thus finishing the loading operation of the articles for one layer. These operations are repeated until the articles B are piled in predetermined layers on a predetermined piling pattern upon the pallet P.

In the operations thus far described, incidentally, when the articles B are to be transferred to the predetermined piling positions at the righthand front and rear portions upon the pallet P, it may be intended to minimize the gap S between the articles B which have already been transferred to the predetermined piling positions at the lefthand front and rear portions upon the pallet P. For this intention, as the case may be, after the article B is moved down slightly rightward of the predetermined piling positions at the righthand front or rear portion upon the pallet P, the transverse trolley 121 is moved slightly leftward to bring the first clamping member 143 into contact with the article B, which has already been transferred to the lefthand front or rear portion, and the supporting members 145 and the second clamping member 144 are retracted to transfer that article B.

As has been described hereinbefore, according to the embodiment under consideration, since the holding mechanism is enabled to move not only in a vertical direction and in a transversely horizontal direction but also in a longitudinally horizontal direction, one row of the piling pattern can be further divided into plural times so that one or plural box-shaped articles B can be separately loaded onto the pallet P. As a result, the pallet loading apparatus can have its construction simplified and its size reduced so that it can be easily installed on the existing factory or warehouse.

In this embodiment, moreover, since only the second one 144 of the paired clamping members 143 and 144 of the holding mechanism 141 is driven to move toward and away from the first clamping member 143, the gap S between the articles B loaded onto the pallet P can be restricted to the thickness of the first clamping member 143.

In this embodiment, still moreover, the holding mechanism 141 is equipped with the supporting members 145 which have their supporting portions 148 protruding from the outside of the second clamping member 144 to below the articles B between the first and second clamping members 143 and 144 thereby to prevent the articles B from dropping down so that it can hold the articles B without fail. Since the second clamping member 144 can have its clamping force weakened, furthermore, the articles B are prevented from being broken. When the articles B are to be released, the second clamping member 144 is enabled to function as a stopper by being retracted after the supporting members 145 have been extracted from below the articles B so that the articles B can be prevented from being positionally displaced. In addition, since the first clamping member 143 does not require any elastic pad but can be constructed of a single plate, the gap between the articles B can be remarkably reduced.

In the embodiment being described, furthermore, since the supporting frame 142 of the holding mechanism 141 can rotate in the horizontal plane, the articles B held thereby can have its direction changed. For example, the articles B can be loaded on the piling pattern shown in Fig. 4. In addition, the articles B can be loaded on various patterns in accordance with the shape of the articles B.

In this first embodiment, incidentally, the first

clamping member 143 is fixedly mounted on the supporting frame 142. The present invention should not be limited thereto but can be modified such that the first clamping member 143 is so disposed that it can be retracted upward. In this modification, the articles B can be pushed by moving down the articles B onto the pallet P, by retracting the supporting members 145, by retracting the second clamping member 144, by retracting upward the first clamping member 143, and by protruding again the second clamping member 144. Thus, the gap S between the articles B can be eliminated.

In this second embodiment, incidentally, the lift 112 is so supported at its centre portion on the stationary post 111 that it can move up and down. However, the present invention should not be limited thereto but can be modified such that the lift 112 is vertically movably supported at its end portion on the stationary post 111.

Fig. 5 shows a second embodiment of the pallet loading apparatus according to the present invention.

Here, this second embodiment basically has similar constructions and operations to those of the foregoing first embodiment, and accordingly the following description will be limited to the different portion, i.e., the holding mechanism.

Reference numeral 241 appearing in Fig. 5 generally indicates the holding mechanism which may be suspended from the carriage 131, as is different from the holding mechanism 141 which is exemplified in the foregoing first embodiment.

The holding mechanism 241 of this second embodiment is constructed to include a supporting frame 242, which is supported on the carriage 131, a first plate-shaped clamping member 243, which is disposed at the lefthand lower portion of the supporting frame 242, a second plate-shaped clamping member 244, which is disposed at the righthand lower portion of the aforementioned supporting frame 242 in a manner to face the first clamping member 243, and a plurality of generally I-shaped supporting members 245 which are disposed outside of that second clamping member 244.

The aforementioned supporting frame 242 is so hinged to the lower portion of the aforementioned carriage 131 through the shaft 134 in a similar manner to the first embodiment that it can freely rotate in a horizontal plane, and is rotationally driven by means of a not-shown drive mechanism.

The aforementioned first clamping member 243 is fixedly attached likewise the first embodiment to the lefthand lower portion of the aforementioned supporting frame 242.

The aforementioned second clamping member 244 is so constructed likewise the first embodiment that it can be protruded toward and retracted away from the aforementioned first clamping member 243 thereby to clamp a predetermined number of articles B together with the first clamping member 243, but is attached in a different manner. Specifically, the aforementioned supporting frame 242 is equipped at both inner sides with a pair of horizontal guide rails 246, with which there are engaged a plurality of rollers 248 borne on plate members 247. To the plate members 247 at both sides, there is attached the

second clamping member 244 which has its upper end portion hinged to the leading end portion of the piston rod of an air cylinder 249 mounted on the aforementioned supporting frame 242. By actuating the air cylinder 249 to protrude and retract its piston rod, the second clamping member 244 is guided by the rails 246 to move toward and away from the first clamping member 243.

In the second embodiment, incidentally, an elastic pad 250 is mounted on the second clamping member 244.

The aforementioned supporting members 245 are constructed such that supporting portions 251 at their lower ends can be protruded from the outside of the second clamping member 244 toward the righthand lower portions of the articles B between the aforementioned first and second clamping members 243 and 244 and retracted away from those righthand lower portions of the articles B thereby to prevent the articles B between the first and second clamping members 243 and 244 from dropping down, but are attached in different positions with different constructions. Specifically, those supporting members 245 are secured at their base end portions to a single pivot pin 252, which in turn is rotatably supported on the outside upper portion of the aforementioned second clamping member 244 by means of a pair of bearings 253. To that pivot pin 252, there is secured one end of a drive lever 254, which has its other end hinged to the leading end portion of the piston rod of an air cylinder 256 hinged to the outside lower portion of the aforementioned second clamping member 244 through brackets 255. Thus, by actuating the air cylinder 256 to protrude and retract its piston rod, the supporting members 245 are rocked about the pivot pin 252 thereby to protrude their supporting portions 251 from the outside of the second clamping member 244 toward the righthand lower portions of the articles B between the aforementioned first and second clamping members 243 and 244 and to retract the same portions 251 away from the righthand lower portions of those articles B. Moreover, the supporting members 245 have their supporting portions 251 so hinged at 257 that they can freely rotate a predetermined angle.

Incidentally, the operations and advantages of the second embodiment are similar to those of the foregoing first embodiment, and accordingly the following description is limited to the advantages intrinsic to this second embodiment.

As has been described hereinbefore, according to the second embodiment, since the supporting portions 251 of the supporting members 245 are made rotatable the predetermined angle by means of the hinge 257, they slide on the lower sides of the articles B while being held in their horizontal positions, when they are extracted from below the articles B, so that the articles B held by the holding mechanism 241 can be brought close to the pallet P or the articles B of the underlying layer, whereby their drop distance can be shortened and whereby the articles B of the underlying layer can be prevented from being broken by the leading ends of the supporting portions 251.

According to this second embodiment, moreover, since the supporting members 245, their driving air

cylinder 256 and so on are attached to the second clamping member 244, the adjustment to cope with the change of the size of the articles B to be held can be done with remarkable ease in case it is changed. In the holding mechanism 141 according to the foregoing first embodiment, specifically, the size adjustment can be performed, in case it is small, exclusively by changing the attached position of the first clamping member 143, but both the attached positions of the bearings 150 of the supporting members 145 and the attached angle of the drive lever 151 have to be adjusted in addition to the attached position of the first clamping member 143 in case the size adjustment is large. In the holding mechanism 241 according to this second embodiment, on the contrary, it is sufficient to change the attached position of the first clamping member 243 in all cases.

The descriptions concerning the specific embodiments of the pallet loading apparatus for loading box-shaped articles are ended. The practise of the pallet loading apparatus should not be limited to the foregoing first and second embodiments. But, in the case of apparatus for moving the holding mechanism in three directions, i.e., in vertical, transverse and longitudinal directions, one or plural arbitrary functions can be combined to drive both the paired clamping members of that holding mechanism, to drive only one of the paired clamping members of the holding mechanism, to equip the holding mechanism with the supporting members, and to make the holding mechanism rotatable in a horizontal plane. Next, a plurality of embodiments of the present invention for loading bag-shaped articles will be described in the following.

Figs. 6 to 9 show a third embodiment of the pallet loading apparatus according to the present invention.

Reference numeral 301 appearing in Figs. 6 and 7 indicates a horizontal platform, at the back (as is located at an upper portion of Fig. 6) of which there is disposed a carrying-in unit 302 for bag-shaped articles B. Adjacent to this carrying-in unit 302, there is disposed a carrying-out unit 303 for loading the articles B, which extends from the platform 301 to the front (as is located at a lower portion of Fig. 6) of the platform 301. A stand-by conveyor 304 is disposed at the carrying-in unit 302, whereas a pallet table 305 is disposed in a horizontal position above the carrying-out unit 303 through a plurality of legs 306.

Moreover, the aforementioned stand-by conveyor 304 is so constructed that a pair of endless belts 308 above a frame 307 are made to run on not-shown front and rear pulleys thereby to convey the bag-shaped articles B fed from the back until they are stopped at a predetermined position.

At the back of the aforementioned stand-by conveyor 304, there is disposed in a continuous manner a carrying-in conveyor 309, above which a pair of guide members 310 are so arranged as to have their spacing narrowed forward. Thus, the articles B fed from the back are conveyed onto the stand-by conveyor 304 such that their longitudinal direction is aligned with the conveying direction of the stand-by conveyor 304 by the coactions of the guide members 310.

Incidentally, the pallet table 305 may be replaced by a pallet conveyor which is disposed similarly to the

aforementioned stand-by conveyor 304 at the carrying-out unit 303 thereby to convey the pallet P.

In the vicinity of the aforementioned carrying-in and carrying-out units 302 and 303, moreover, there is erected upright a stationary post 311 which is disposed at the righthand side of the aforementioned platform 301. On that stationary post 311 at the side of the carrying-in and carrying-out units 302 and 303, i.e. at the lefthand side, there is vertically mounted a lift 312 which is elongated in a horizontal direction along the carrying-in and carrying-out units 302 and 303, i.e. in a horizontal direction.

Specifically, the aforementioned stationary post 311 is equipped at its front and rear sides, respectively, with vertical guide rails 313. At the righthand side portion of the aforementioned lift 312, there are borne through a pair of front and rear opposite supporting frames 315 a plurality of rollers 314, which are in engagement with the aforementioned guide rails 313. Moreover, the lift 312 is moved up and down by the action of a drive mechanism which is constructed to include a lift motor 316 mounted on the upper end of the stationary post 311.

On the aforementioned lift 312 at the side of the carrying-in and carrying-out units 302 and 303, i.e. at the lefthand side, furthermore, there is carried a transverse trolley 321 which is elongated in a direction to intersect the lift 312, i.e., in a transverse direction and which is made freely movable in a horizontal direction between the carrying-in and carrying-out units 302 and 303.

Specifically, the aforementioned lift 312 is equipped at its upper and lower portions, respectively, with longitudinally horizontal guide rails 322. On the righthand end portion of the aforementioned transverse trolley 321, moreover, there are borne through a supporting frame 324 having a generally C-shaped front view a plurality of rollers 323, which are in engagement with the aforementioned plural rollers 323. Still moreover, the transverse trolley 321 is driven to move in a horizontal direction by the action of a not-shown drive mechanism.

On the aforementioned transverse trolley 321, furthermore, there is movably mounted a carriage 331 which is enabled to move in a horizontal direction to intersect the moving direction of the transverse trolley 321.

Specifically, the aforementioned transverse trolley 321 is equipped at its front and rear side portions, respectively, with transversely horizontal guide rails 332. On the front and rear side portions of the aforementioned carriage 331, respectively, there are borne a plurality of rollers 333, which are in engagement with the aforementioned guide rails 332. Moreover, the carriage 331 thus constructed is driven to move in a horizontal direction by the action of a not-shown drive mechanism.

Furthermore, a holding mechanism 341 for holding the articles B is suspended from the lower portion of the aforementioned carriage 331. This holding mechanism 341 is constructed, as is better seen from Fig. 9, to include a supporting frame 342, which is suspended from the carriage 331, a pair of plate-shaped scooping members 343 generally having a shape of letter "L", which are oppositely attached to

the supporting frame 342, and a rod-shaped push member 344 which is attached to the lower portion of the aforementioned supporting frame 342 between those paired scooping members 343.

In this third embodiment, the aforementioned supporting frame 342 is so suspended from the lower portion of the aforementioned carriage 331 that it can freely rotate in a horizontal plane, and is driven to rotate by the action of a not-shown drive mechanism.

The aforementioned paired scooping members 343 are hinged to the aforementioned supporting frame 342 by means of pivot pins 345 and are adapted to be opened and closed by the action of a not-shown drive mechanism thereby to scoop and hold a bag-shaped article B with supporting portions 346 at their leading ends.

The aforementioned push member 344 is so attached to the aforementioned supporting frame 342 through a rod 347 that it can freely move up and down, and is adapted to ascend and descend by the action of a not-shown drive mechanism.

Next, the operations of this third embodiment will be described in the following.

First of all, a vacant pallet P is placed on the pallet table 305.

By moving the lift 312, the transverse trolley 321 and the carriage 331, in this meanwhile, the holding mechanism 341 is brought to above the stand-by conveyor 304. Then, the scooping members 343 of that holding mechanism 341 are prepared to be opened, and the push member 344 is prepared to ascend. Then, by rotating the holding mechanism 341, the directions of the pivot pins 345 of the scooping members 343 are made coincident with the conveying direction of the stand-by conveyor 304.

After that, the bag-shaped article B is carried onto the stand-by conveyor 304 by the action of the carrying-in conveyor 309, and the longitudinal direction of the article B is aligned with the conveying direction of the stand-by conveyor 304 by the coactions of the guide members 310. Then the article B is stopped at a predetermined position above the stand-by conveyor 304, and the succeeding articles B is prevented from being carried onto the stand-by conveyor 304.

When the article B is stopped at the predetermined position of the stand-by conveyor 304, the lift 312 is moved down to bring the paired scooping members 343 of the holding mechanism 341 to both sides of that article B. After that, the scooping members 343 are closed to insert their supporting portions to below the article B.

After the lift 312 is subsequently moved up, both the transverse trolley 321 and the carriage 331 are moved to bring the holding mechanism 341 to above a predetermined piling position on the pallet P. Then, as shown in Fig. 9(A), the lift 321 is moved down to position the article B held on the holding mechanism 341 slightly above the predetermined piling position.

Next, as shown in Fig. 9(B), the push member 344 is protruded down and the scooping members 343 are opened, while pushing the centre portion of the article B, until this article B is placed on the predetermined piling position, while being pushed by the push member 344, as shown in Fig. 9(C).



On the other hand, in case the direction of the article B to be stopped on the stand-by conveyor 304 is different from the piling direction of the same on the pallet P, the holding mechanism 341 is turned 5 until the direction of the article B comes into alignment with the piling direction, as shown in Fig. 8.

These operations are repeated so that the articles B are piled on a predetermined piling pattern in a predetermined number of layers upon the pallet P.

10 As has been described hereinbefore, according to this third embodiment, since the holding mechanism 341 having the paired clamping members 343 is enabled to move in the vertical direction, in the longitudinal direction and in the transverse direction, 15 one or plural bag-shaped articles B can be separately loaded onto the pallet P. As is different from the conventional pallet loading apparatus, there are required neither the arranging table for arranging the articles of one layer nor the carriage for supporting 20 and carrying the articles B of one layer. Nor is required a mechanism for vertically moving the pallet P loaded with the articles B. As a result, the pallet loading can have its size so reduced that it can be installed on the existing factory or warehouse with- 25 out any difficulty. Moreover, the loading apparatus has its most portion supported by the stationary post 311 so that its installation is facilitated.

According to this third embodiment, moreover, since the holding mechanism 341 is equipped with the push 30 member 344, the deformations of the articles B and the unbalance of the loads when the bag-shaped articles B are to be transferred can be corrected so that the piled articles B can enjoy a satisfactory appearance while being prevented from dropping to 35 pieces.

According to the third embodiment, furthermore, since the holding mechanism 341 can be rotated in the horizontal plane, the articles B held thereby can have their direction changed so that they can be piled 40 on various piling patterns.

Figs. 10 and 11 show a fourth embodiment of the pallet loading apparatus according to the present invention.

Here, this fourth embodiment basically has similar 45 constructions and operations to those of the foregoing first or third embodiment, and accordingly the following description is restricted to the different portion, i.e., the holding mechanism.

Reference numeral 441 appearing in Figs. 10 and 11 50 generally indicates a holding mechanism which may be suspended from the carriage 131 or 331, as is different from the holding mechanism 141 or 341 exemplified in the foregoing first or third embodiment.

55 This holding mechanism 441 is constructed to include a supporting frame 442, which is suspended from the carriage 131 or 331, a pair of scooping members 443, which are attached to that supporting frame 442 at both its lower side portions, and a push 60 member 444 which is disposed below the aforementioned supporting frame 442 between those scooping members 443. This push member 444 and the aforementioned two scooping members 443 are connected by means of a later-described coacting 65 mechanism 445 so that the push member 444 is made

to coact when the scooping members 443 are driven.

The aforementioned supporting frame 442 is so suspended from the lower portion of the aforementioned carriage 131 or 331 by means of a shaft 446 that 70 it can freely rotate in a horizontal plane, and is driven to rotate by the action of a not-shown drive mechanism.

Each of the scooping members 443 at both sides is constructed to include a plate member 451 and a plurality of generally L-shaped supporting pawls 452 75 which are secured to the leading end portion of that plate member 451. Those scooping members 443 are enabled to be opened and closed by rotatably laying pivot pins 453 in the lower portions of the aforementioned supporting frame 442 at both sides, by 80 securing a pair of rocker arms 454 to those pivot pins 453, and by attaching the base end portions of the aforementioned plate members 451 to the outer end portions of the paired rocker arms 454.

Moreover, to the end portions of the pivot pins 453 85 at both sides, there are secured one-side end portions of drive arms 455 having their other end portions, to which there are hinged the leading end portions of the piston rods of air cylinders 456 hinged to the front and rear side portions of the aforementioned sup- 90 porting frame 442. By synchronously actuating the front and rear air cylinders 456 to protrude and retract their piston rods, the pivot pins 453 at both sides are rotated to open and close the scooping members 443 95 at both sides.

To the aforementioned both-side pivot pins 453, still moreover, there are secured respective arms 457 which are hingedly connected by means of a connect- 100 ing lever 458 so that the pivot pins 453 are enabled to rotate in complete synchronism with each other. As a result, the scooping members 443 at both sides are completely synchronized and can be driven, too, by one of the air cylinders 456.

The aforementioned push member 444 is con- 105 structed such that round rods 461 at both sides are connected by means of a pair of front and rear plate members 462. From the upper sides of both the plate members 462 at their centres, there are erected upright a pair of sliding rods 463, on which sleeves 110 464 are slidably fitted. Into the upper end portions of both the sliding rods 463, there are screwed a pair of nuts 465 which act as stoppers.

Moreover, coil springs 466 are sandwiched between the aforementioned sleeves and plate mem- 115 bers 464 and 462.

In this fourth embodiment, furthermore, the aforementioned push member 444 is so suspended directly from the aforementioned coacting mechanism 445 that it can move up and down. Specifically, 120 that coating mechanism 445 is constructed such that retaining pins 471 are formed to project from the inner end portions of the rocker arms 454 to which the aforementioned both-side scooping members 443 are attached, and such that engagement plates 473, 125 which are formed at both end portions with slots 472 to engage with those pins 471, are secured to the sleeves 464 which support the aforementioned push member 444 in a vertically movable manner. Thus, when the aforementioned both-side scooping mem- 130 bers 443 are opened, the inner end portions of the

rocker arms 454 rock downward. As a result, the engagement pins 471 push down the engagement plates 473 while moving in the slots 472 so that the sleeves 464 push down the plate members 462 of the push member 444 through the springs 466. When the scooping members 443 are closed, on the contrary, the inner end portions of the rocker arms 454 rock upward. As a result, the engagement pins 471 push up the engagement plates 473 while moving in the slots 472 so that the sleeves 464 pull up the plate members 462 of the push member 444 through the paired nuts 465 and the sliding rods 463.

Next, the operations of the fourth embodiment thus constructed will be described in the following.

15 Upon the following description, incidentally, let it be assumed that the holding mechanism 441 is suspended from the carriage 331 of the foregoing third embodiment.

The article B is stopped at a predetermined position 20 above the stand-in conveyor 304 which is disposed at the carrying-in unit 302.

Then, the lift 312 is moved down to a predetermined position along the stationary post 311, and the push member 444 of the holding mechanism 441 is brought into abutment contact with the centre portion of the upper side of the article B thereby to rearrange the article B. After that, the air cylinders 456 are actuated to protrude their piston rods so that the both-side scooping members 443 are closed to scoop 30 up and hold the article B and so that the push member 444 is moved up.

At this time, the push member 444 is brought by the suitable pressure of the springs 466 into abutment contact with the article B so that the article B is 35 prevented from being broken, and is moved up in accordance with the closing operations of the scooping members 443 so that the scooping and holding operations of the article B is not obstructed.

Next, the lift 312 is moved up, and the transverse 40 trolley 321 is moved forward along the lift 312. If necessary, moreover, the carriage 331 is moved to the left along the transverse trolley 321, and the holding mechanism 441 is rotated. Thus, the article B held by the holding mechanism 441 is positioned 45 above a predetermined piling position of the pallet P which is placed on the carrying-out unit 303.

Next, the lift 312 is moved down to bring the article B to slightly above the predetermined piling position on the pallet P. After that, the air cylinders 456 are 50 actuated to retract their piston rods so that the scooping members 443 are opened to drop the article B.

Next, the lift 312 is moved down so that the push member 444 is brought to abut against the centre 55 portion of the upper side of the article B transferred thereby to rearrange the article B.

Since, by this time, the push member 444 has already been moved down by the opening operations of the scooping members 443 and positioned below 60 the leading end portions of the generally L-shaped supporting pawls 452 of the scooping members 443, there is no fear that the supporting pawls 452 may contact with the article B which has been transferred to the adjacent position.

65 Next, the lift 312 is moved up, and the transverse

trolley 321 is moved backward. If necessary, moreover, the carriage 331 is moved to the right, and the holding mechanism 441 is rotated to a position above the stand-by conveyor 304.

70 Moreover, the operations thus far described are successively performed to transfer a predetermined number of articles B onto the predetermined piling positions on the pallet P. Those operations are repeated to pile the articles B on a predetermined 75 piling pattern in predetermined layers upon the pallet P.

In the operations thus far described, incidentally, in case the article B is to be arranged on the pallet P of the carrying-out unit 303, the push member 444 can be brought to abut against the centre portion of the upper side of the article B without any descent of the lift 312 by making sufficiently long the ascending and descending stroke of the push member 444 in accordance with the opening and closing operations 85 of the scooping members 443.

As has been described hereinbefore, according to this fourth embodiment, since the push member 444 is moved up and down by the closing and opening operations of the scooping members 443, there is 90 required no drive means for driving the push member 444, which protrudes upwardly of the supporting frame 442. In case the holding mechanism 441 is suspended from the carriage 131 or 331, therefore, there is required no wide space in between, and the 95 holding mechanism 441 itself can be so attached easily as to freely rotate in the horizontal plane. Still moreover the holding mechanism 441 can have its weight reduced. Furthermore, the ascent and descent of the push member 444 can be simply controlled 100 because they are synchronized in a mechanical manner with the opening and closing operations of the scooping members by means of the coacting mechanism 445.

The description of the specific embodiments exemplifying the pallet loading apparatus for loading the bag-shaped articles is ended.

#### CLAIMS

1. A pallet loading apparatus comprising: a post erected upright in the vicinity of carrying-in and 110 carrying-out units which are disposed adjacent to each other; a lift elongated in a horizontal direction along said carrying-in and carrying-out units and so disposed that it can move up and down along said post; a transverse trolley elongated in such a 115 horizontal direction as to intersect said lift and so disposed that it can move in a horizontal direction along said lift between said carrying-in and carrying-out units; a carriage so disposed that it can move in such a horizontal direction along said transverse 120 trolley as to intersect the moving direction of said transverse trolley; and a holding mechanism suspended from the lower portion of said carriage.

2. A pallet loading apparatus as set forth in Claim 1, wherein said holding mechanism includes a pair of 125 clamping members both driven to move toward and away from each other for clamping together a box-shaped article from both the sides of the same.

3. A pallet loading apparatus as set forth in Claim 2, wherein the paired clamping members of said 130 holding mechanism are so driven by a cylinder as to

move back and forth in synchronism with each other.

4. A pallet loading apparatus as set forth in Claim 1, wherein said holding mechanism includes a pair of clamping members for clamping together a box-shaped article from both sides of the same, one of said clamping members being driven to move toward and away from the other.

5. A pallet loading apparatus as set forth in Claim 2, 3 or 4, wherein said holding mechanism further includes a supporting member adapted to move to and from below the article, which is clamped between said paired clamping members, for supporting the article between said clamping members from the lower side of the same.

6. A pallet loading apparatus as set forth in Claim 1, wherein said holding mechanism includes a pair of scooping members for scooping up a bag-shaped article from both sides of the same.

7. A pallet loading apparatus as set forth in Claim 6, wherein said holding mechanism further includes a push member made movable up and down between said paired scooping members.

8. A pallet loading apparatus as set forth in Claim 7, wherein the push member of said holding mechanism is moved up and down in mechanical response to the closing and opening operations of said scooping members.

9. A pallet loading apparatus as set forth in Claim 1, 2, 3, 4, 5, 6, 7 or 8, wherein said holding mechanism is so suspended from said carriage that it can rotate in a horizontal plane.

10. Pallet loading apparatus, substantially as hereinbefore described with reference to the accompanying drawings.